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Episodic melting and magmatic recycling along 50 Ma in the Variscan belt linked to the orogenic evolution in NW Iberia

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Abstract. The advent of a large amount of more precise U-Pb age data on Variscan granitoids from NW Iberia in recent years has provided a more focused picture of the magmatic history of the Western European Variscan belt (WEVB). Based on these data, three main pulses of magmatic activity seem to be well established.

Variscan granitoid magmatism in NW Iberia is an example of the intimate linkage between granitoid magma production and plate convergence/collisional/post-collisional geodynamic scenarios. In the Western European Variscan belt (WEVB) realm, the major stages of convergent tectonics and its aftermath, are recorded by granitoid suites generated in a time span of about 50 million years (*ca.* 340-290 Ma). There is however some ongoing controversy regarding: i) whether there was a significant magmatic event in the early Carboniferous, for which there is hitherto scarce evidence, and ii) whether the Variscan magmatic activity was continuous or it rather occurred through discrete and relatively short-lived pulses. Unravelling these issues is one of the key elements to better constrain and interpret the different processes involved in the collisional scenarios that lead to the Variscan orogeny in Iberia during Late Paleozoic times [1-5] and the subsequent development of the Ibero-Armorican Arc (IAA) [6].

The advent of a large amount of more precise U-Pb age data on Variscan granitoids (and some volcanic rocks) from NW Iberia in recent years has provided a more focused picture of the magmatic history of the WEVB, providing solid ground for interpretations that link periods of more intense magmatic activity with large-scale crust-mantle processes involved in the collisional orogeny and the subsequent development of the Ibero-Armorican Arc.

Based on the observation of those more precise U-Pb ages and new data, three main pulses of magmatic activity seem to be well established. These pulses recycle (re-melt) the previously formed granitoid rocks (Figure 1 and 2):

1) Post-orogenic granitoid suite (POS henceforth) (*ca.* 305-290 Ma), that intrudes all the structural domains of the orogen, including the foreland fold and thrust belt, which makes the WEVB rather unique. The POS includes a large number of volumetrically minor intrusions of mafic and ultramafic rocks. This magmatic event has been extensively studied and dated. The POS has been interpreted as generated by lithospheric delamination triggered by the oroclinal bending of the mountain belt.



2) Syn-extensional collapse granitoids (*ca.* 325-315 Ma): mostly crustal (S-type) peraluminousleucogranites generated by decompression melting following the extensional collapse of the mountain belt.

3) A third suite of Variscan granitoids, not considered in most of the published models, has been found with ages clustering around 340 Ma. In addition, a significant amount of *ca.* 340 Ma zircon xenocrysts has been found in the *ca.* 320 Ma syntectonicleucogranitoids of the Tormes Dome and surrounding areas, in the *ca.* 305 Ma Toledo Anatectic Complex and the western part of the Gredos Massif, and also as detrital zircons in Variscansyn-orogenic sediments.

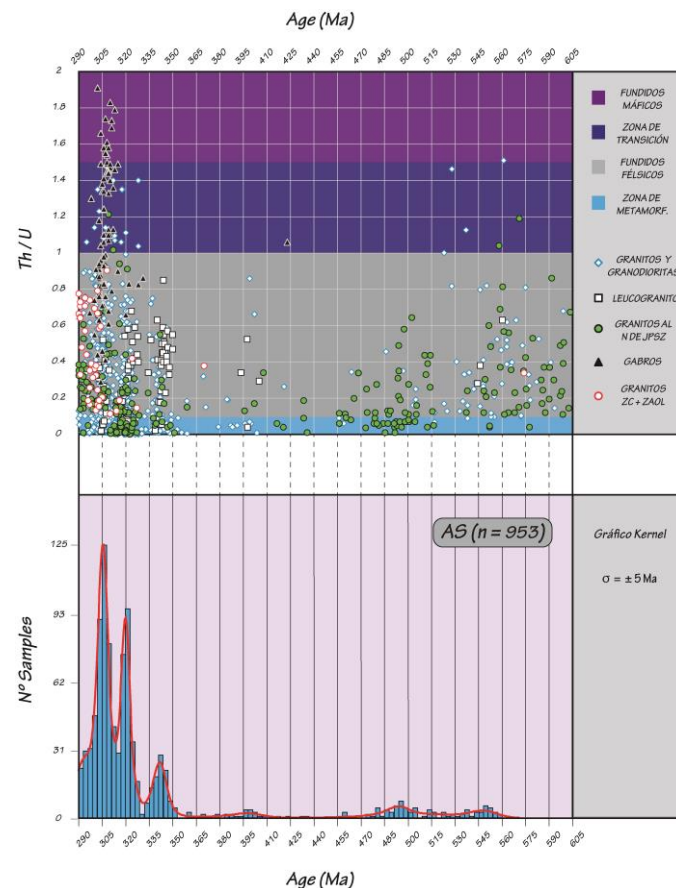


Figure 1.A) Graph [Th/U] vs. Age (Ma).and B) Histogram and Kernel distribution (KDE) of single zircon U-Pb ages of Variscan granitoids in NW Iberia [7]. Data from[8-17].

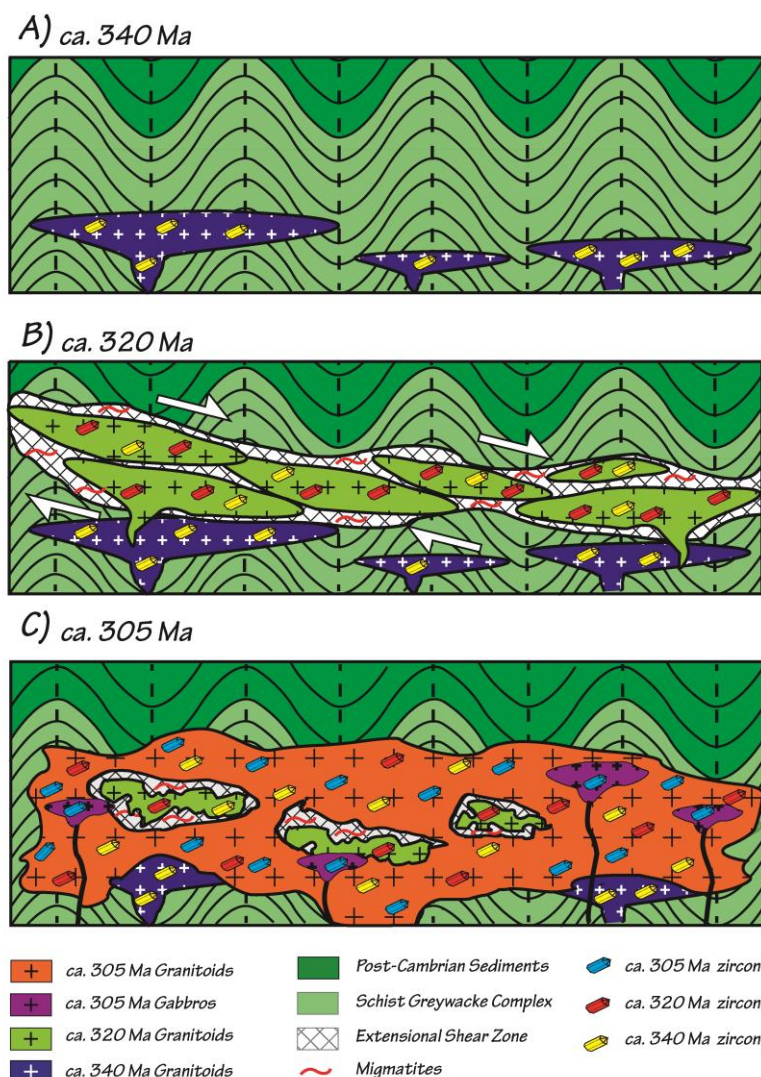


Figure 2. Proposed conceptual model for the recycling and re-melting of the three magmatic events found in NW Iberia according to the ages of the zircon grains found in them. A: Felsic magmatism of uncertain origin at ca. 340 Ma. B: Felsic magmatism at ca. 320 Ma associated with the orogenic collapse, extensional shear zones and extensive migmatization recycling previous 340 Ma granite bodies. C: Felsic and mafic magmatism of ca. 310-295 Ma that produced new zircons and recycled zircons from the two previous magmatic Variscan events. The latter event is interpreted to have occurred due to oroclinal triggered lithospheric delamination.

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